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DEVOTED TO THE ADVANCEMENT OF ASTRONOMY AND ALLIED SCIENCES

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THE JOURNAL
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# DISTORTED SOLAR HALOS.*

BY A. F. HUNTER.

THERE is a class of halos which I have not seen described in scientific publications, although if any account of them exists I may easily have overlooked it, so vast is the field of literature on the subject.

On March 25th, 1899, at 10.30 a.m., I saw a solar halo at Barrie, Ont., consisting of a primary circle around the sun, but the sun was not at its centre, i.e., it was excentric (Fig. 1). On measuring the parts with a long-armed compass, I found that the instrument confirmed what my unaided eye had detected. The inner edge of the top part of the circle was 21½ degrees from the sun's upper edge, and the inner edge of the lowest part of the circle was 23 degrees from the sun's lower edge,—a difference of about three times the sun's width.

This eccentricity is not difficult to understand, and as the observer of a phenomenon has the first right to speculate on its causes, I will offer an explanation of it. With a common glass

* A portion of a paper on Halos, read at the meeting of the Society in Toronto, November 6th, 1917.

prism one may see how the position of the image of an object changes (a distant street lamp at night, for example, which gives rays of light that are nearly parallel to each other, and therefore resemble the sun's rays in that particular) as the inclination of the prism to the object changes. When the prism is held at right angles to the line of sight, the image of the object is in the same horizontal plane as the object itself. But inclining the top of the prism toward the object, the image of it rises above the horizontal plane; and on the other hand, inclining the bottom of the prism

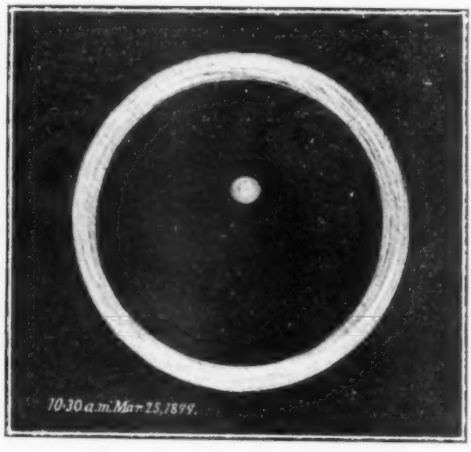


FIG. 1
Excentric Solar halo observed at Barrie, Ont.

toward the object makes the image fall. If, therefore, the sun's rays shine through very small prisms of snow that have their upper ends inclined toward the sun, the sun images, and consequently the entire halo, will be somewhat elevated relatively to the sun. But if the small prisms have their top ends inclined away from the sun, the opposite result will follow, viz., the halo will be somewhat lowered relatively to the sun, as in the example from nature, now under consideration. Hence, I concluded that the snow prisms

producing this excentric halo had their longer axes situated in a horizontal plane. It is only within a limited range that this rule can be true for the ordinary prism. And when the sun had an intermediate altitude in the sky, as it had at 10.30 a.m. on the abovementioned date, it was within the range in which the phenomenon could occur.

This conclusion agrees very well with what we are already familiar in nature. From seeing the horizontal wisps that are often projected from the tops of thunder clouds or from cirrus clouds, we know that there are lines of strong forces in the higher air driving snow particles in horizontal directions. Indeed, the name "cirrus" itself is the Latin word for a curl, especially a curl of hair, and expresses the wispy character of such clouds driven horizontally. Accordingly, the only explanation that will suffice is that the snow particles were arranged horizontally by lines of electro-magnetic forces.

Two days later, March 27th, 1899, also at 10.30 a.m., I observed a solar circle 23½ degrees from the sun's upper edge, and 22½ degrees from its lower edge. This was almost the reverse of the halo first seen. In this later example, the snow crystals must have had their longer axes ranged in the vertical plane, i.e., inclined toward the sun.

### ELLIPTIC OR CIRCUMSCRIBED HALOS.

On May 31st, 1904, at a point some 15 miles northwest of Barrie, I observed a halo of the sun consisting of an ordinary first circle surrounded by an ellipse, which had likewise the sun for its centre (Fig. 2). The sheet of haze producing this halo was thin at first, but it covered the entire sky and seemed to be at a very high altitude. As time went on, the haze continued to thicken, and seemed to come into lower strata of the air. But no definite *forms* of clouds were to be seen at any time, not even after the haze had become too thick for the halo to be seen. The atmospheric disturbance appeared to be of a wide-reaching nature. I was in the open air during the whole time the halo was visible, and

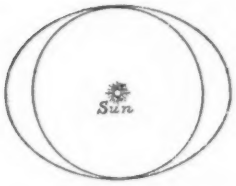


FIG. 2

Elliptic halo observed in Simcoe Co., Ont., May 31st, 1904.

had a good opportunity of watching its progress. At that time I sent the following paragraph with a diagram to the Journal of this Society (1904), then published as an annual.

ELLIPTICAL SOLAR HALO,

Observed in Simcoe Co., Ont., May 31, 1904.

(TRANS. ROY. ASTRON. SOC. CAN., 1904, P. 62.)

At 9.45 a.m. I first observed parts of both curves—the circle and the ellipse—at the right-hand side. By 10 o'clock the ellipse had become intensely bright all around the sun, and the circle was less bright, the intensity being greatest at the top and the bottom where the two curves overlapped. By 11.20 a.m., the halo was clouded over, and only the circle showed very faintly through the cloud film. No trace of mock suns or other similar formations at the sides could be seen at any time. As the mock sun formations at the right and left are much the commonest form of solar halo, I think this unusual elliptical form is worthy of note. It may be added that the cyclone (of which this phenomenon was the forerunner) was of very general or widespreading form, as rain began to fall at 9 p.m. and continued with some interruptions for two days.

It will be necessary to point out that the circle had some color, i.e., was a halo of refraction, but the ellipse was colorless, i.e., it

was a halo of reflexion. It could not be possible to confuse the two curves on this occasion, so distinct were both of them.

Mr. C. W. Nash, the provincial naturalist, related to me that he saw an elliptic halo, along with the ordinary first circle, in a halo of the sun, on Lake Manitoba, in December, 1884, but his observation was never published. This was the only specific example of the ellipse in his experience. The halo began with the ellipse in the morning and kept changing, the circle finally being left. The half-breed who was with him as driver, said that a big storm would follow, and that they should keep near the shore. Sure enough, it was followed later in the day by a terrible blizzard.

The only other account I have met in Canadian records, of a halo bearing any resemblance to the one I reported in 1904, was a solar halo recorded by Mr. A. Clifford Thomson, P.L.S., in the *Canadian Journal* for September, 1862, with a diagram which I reproduce here (Fig. 3). He describes the halo as *"Seven mock*

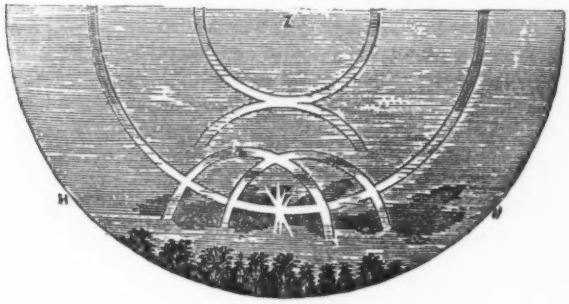

FIG. 3

Halo observed on the Muskoka River, Ont., Nov. 10, 1861, by A. Clifford Thomson, P.L.S.

*suns."* The Toronto Observatory record reported a lunar halo for the same date, Nov. 10, 1861, at 8 p.m., but otherwise no unusual features were noted at Toronto.

From the *Canadian Journal*, September, 1862, p. 462:—

NOTICE OF MOCK SUNS, AS SEEN NEAR THE MUSKOKA RIVER, IN NOVEMBER, 1861.

By A. Clifford Thomson, P.L.S.

"While camped near the mouth of the Muskoka River, Canada West, on the 10th of November, 1861, I observed at about 9.40 a.m. the somewhat remarkable phenomenon of seven mock-suns, as shown in the accompanying sketch. In this drawing the line H.H. represents the horizon, and the point Z the zenith. Unfortunately, I had not any instrument with me at the time, to enable me to note the position of the halos; but two of these were quite eccentric, both with regard to the sun and the zenith. The sun was too bright to be regarded with the naked eye, though the atmosphere was slightly hazy. The wind was light, and from the N.W.

"I venture to send this brief notice to the *Canadian Journal*, as I believe the phenomenon to which it refers is rarely witnessed in so southern a latitude. It was observed on this occasion at Orillia, and other places more or less distant from the point at which the above sketch was taken on the Muskoka River. The latitude of this point is 45° 10′ N."

When we compare together the two diagrams (Fig. 2 and Fig. 3), it will appear that, of the so-called intersecting circles in Fig. 3, the inner segments might be taken to form a circle, and the outer segments, an ellipse. At the time Mr. Thomson recorded this observation fifty-six years ago, it was usual to interpret this portion of a halo as two intersecting circles. And it would appear to be still an interpretation, if we may judge from the article by Dr. Besson on halos in the Washington *Monthly Weather Review* for July, 1914. As an example of a halo containing elements similar to those seen by Mr. Thomson, we reproduce just one example, viz., one seen by Vice-Admiral Kalmar at Pola, on March 26, 1896, and described by Dr. Besson with a diagram to which is affixed an interpretation as above mentioned (Fig. 4). Pola is

the headquarters of the Austrian fleet on the Adriatic, and often figured during the past summer as a point attacked by Italian airmen. Its latitude is about 44½ deg. N.

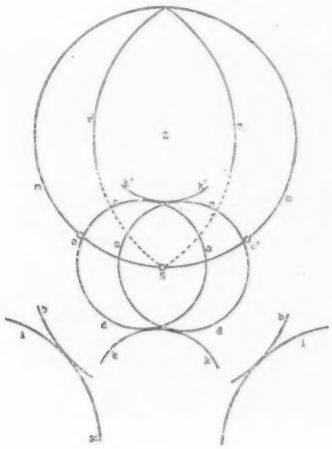

FIG. 4

Halo observed by Rear Admiral A. von Kalmar, at Pola, on March 26, 1896, embracing: Halo of 22° (a), circumscribed halo of 22° (c–d), ordinary parhelia (e, e'), extraordinary tangent arcs of the halo of 22° (k, k'), infralateral tangent arcs (i, i') accompanying fragments of the 46°-halo (b, b), the parhelic circle (m), the oblique arcs of the anthelion (r, r'). S, the sun; Z, the zenith.

It is possible that we may have two circles intersecting each other, as I have just shown in Fig. 1 an example of one excentric circle, whose eccentricity, however, is in the vertical direction. But I have no doubt of the interpretation of the elliptic forms as halos of reflexion, and it will be a duty in future obesrvations to note carefully whether a curve has color.

In this connection I should also describe a solar halo which I saw at 1 p.m., June 9, 1917, consisting of a circle with very little color, in the position of the primary circle, that is, at approximately 22 degrees from the sun, and a whitish curve visible finally

as a quadrant of an ellipse (Fig. 5). The latter, at the time when it became possible for me to measure it, and when it was only a quadrant, had a distance of 30 degrees from the sun at the nearest part, but at the earlier time I had seen it almost entirely around

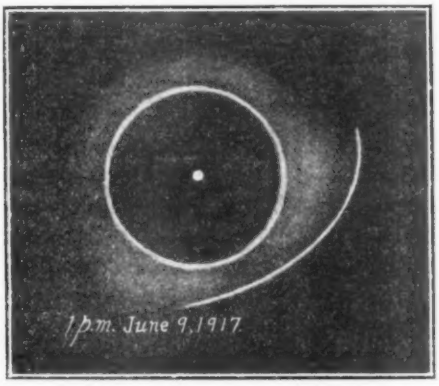


FIG. 5

Halo with quadrant of ellipse.

the sun, though just then I was unable to take its measurements. This ellipse was unusual in having the fluorescence on the inside, not on the outside as the primary circle has, the outside here being dark, and it was this circumstance that first called my attention to it as not being the first or primary circle itself. All signs of the ellipse disappeared by 2.15 p.m., and the circle with color remained for a short time afterward. Cirrus haze was abundant, and then clouds.

Prof. Cherriman mentioned a halo seen at the Toronto Observatory on March 9, 1841, having a radius of 30 degrees, which agrees as to its angle with the observation I made on June 9, 1917. (See "On the Atmospheric Phenomena of Light," *Canadian Journal* (First series), Vol. 1, p. 27.)

But Dr. Besson mentions several halos of abnormal radius

(in his article in the U. S. Weather Review for July, 1914) regarding which he makes this remark: "the ordinary halo (22 degrees) is almost always simultaneously visible."

Again, as the observer of a phenomenon, I will venture to use my right to speculate as to its causes, and to offer an explanation, as, in the words of a notable French writer, "it requires a theory to satisfy the mind."

EXPLANATION OF THE ELLIPSE.

By means of this simple diagram (Fig. 6) we can arrive at an understanding of this elliptic form of halo. If we suppose that

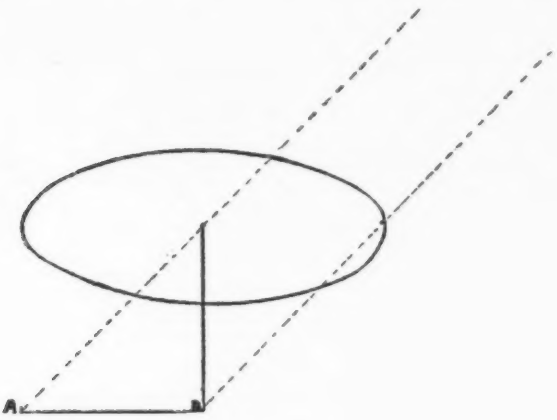


FIG. 6

A circular halo viewed edgewise.

an observer at B is looking at a great white horizontal circle passing through the sun's disk, for example, made by a film of haze, extending, say, at a height of ten miles, he would see it as a great circle with the zenith as its centre and the sun in its rim. But an observer at A, say ten miles distant from B, and with the luminary at, say, an altitude of 45 degrees, would see it as an ellipse with the sun as its centre, because a horizontal circle formed by re-

flexions becomes by projection a flattened circle, *i.e.*, an ellipse.

In the previous example we saw a case of a distorted halo of refraction. Here in the elliptic form we have what we may regard as a distorted halo of reflexion, in which a horizontal circle, seen obliquely or partly edgewise, is flattened into an ellipse. It is never directly overhead like the parhelic circle with its centre overhead, and it probably occurs at a very great height above the ground, 10 miles or upward. For parallel light forming a halo of reflexion, there would be only a certain range of visibility within which it could be seen. This range would necessarily be small and hence the elusive and rare appearance of the elliptic halo.

This concludes what I have to say in regard to distorted halos, both of refraction and of reflexion, in which we see nature at her best, like "sports" in biology.

# THE EARTH AND POPULATION.

By Otto Klotz.

RECENTLY there was published a monumental monograph of 466 pages, Appendix A., Vol. I., Census of the Commonwealth of Australia, by G. H. Knibbs, C.M.G., F.S.S., F.R.A.S., entitled "The Mathematical Theory of Population, of its Character and Fluctuation, and of the Factors which Influence Them." It is a work that marks a distinct epoch in census statistics. This brief note is concerned with deductions derived from the data of population and its rate of increase.

On page 31 of the above work we read: "This table shows, for the period 1804 to 1914, rates of annual increase ranging between 0.0015 and .0121 and averaging about 0.00864"; also that the world's population for 1914 was 1,649 millions. In an adjoining table we find the annual increase per 10,000 population to be for the quinquennium 1906-1911, for France 16, for England and Wales 104, for German Empire 136, for United States 182, for Commonwealth 203, and for Canada 298. The weighted average —including other countries not here given—is 115.9, which is equivalent to 1.156 per cent. From the above data we have selected the following for the subsequent computations and deductions: (a) the lowest annual increase between 1804 and 1914, .0015; (c) the average annual increase for that period .00864; (b) the annual increase for France for 1906-1911 .0016; and (d) the weighted average annual increase for 1906-1911, .001159.

The first query that suggests itself is—how far back would those four rates of increase respectively take us if we assume an ancestral pair? We have

(a), $(1{\cdot}0015)^n = 8{\cdot}245 \times 10^8$, hence $n = 13{,}697$ years.
(b), $(1{\cdot}0016)^n = 8{\cdot}245 \times 10^8$, " $n = 12{,}842$ "
(c), $(1{\cdot}00864)^n = 8{\cdot}245 \times 10^8$, " $n = 2{,}386$ "
(d), $(1{\cdot}01159)^n = 8{\cdot}245 \times 10^8$, " $n = 1{,}782$ "

These figures are interesting, for even the lowest rate of increase for the 19th century does not carry us back to the time required by the geologist and anthropologist for the first evidence of the appearance of man. And the rate of increase for the quinquennium 1906-1911 would start the career of the first pair in A.D. 132! We conclude, therefore, that the rate of increase in past ages has been less than the lowest of the past century, and very much less than our present rate. We shall presently see that our present rate must give us pause, unless we adopt the attitude, "What has posterity done for me?"

As we can readily look back on the world's written history for 2,000 years, we may well ask what will the population be in 1,000, in 2,000 years, hence?

Using the same data as before we have:—

(a), $(1{\cdot}0015)^{1911} \times 16{\cdot}49 \times 10^8 = 7{\cdot}382 \times 10^9$, for 2000 years $= 3{\cdot}305 \times 10^{10}$
(b), $(1{\cdot}0016)^{1100}$ " $= 8{\cdot}157 \times 10^9$ " " $= 4{\cdot}035 \times 10^{10}$
(c), $(1{\cdot}00864)^{1600}$ " $= 8{\cdot}983 \times 10^{12}$ " " $= 4{\cdot}893 \times 10^{13}$
(d), $(1{\cdot}01159)^{1900}$ " $= 1{\cdot}666 \times 10^{14}$ " " $= 1{\cdot}684 \times 10^{17}$

This means that at the rate of increase of France, (b), the population of the world would in a thousand years be about five times that at present, and in 2,000 years 25 times that of now. But see what would happen if the increase of 1906-1911 were maintained for a thousand years, a very short period even in the history of man, it would be 100,000 times the present population; and in 2,000 years, the stupendous figure of ten thousand million times the present population.

Don't imagine for a moment that this is juggling with figures, for they are sound deductions from the above data. Unless the data can be disproved the deductions stand.

Let us follow another line of reasoning. Goldsmith writes:

> "A time there was, ere England's grief began
> When every rood of ground maintain'd its man."

This is poetic license about the amount of land required. A fair estimate for the support of a person is taken at two acres, which

would mean 320 persons to the square mile, about that of Germany, France being 191. Let us take roughly that one-quarter of the surface of the earth is land, and that three-quarters of this, which is a high estimate, may ultimately be put under cultivation. Taking the radius of the earth as 3,960 miles, its surface is 5.4937 $\times 10^{15}$ sq. feet, hence the land ultimately available $1.03 \times 10^{15}$ sq. feet, and this would support at the maximum $1.182 \times 10^{10}$ people.

Hence we may ask in how many years will the present population reach the maximum possible $1.182 \times 10^{10}$ that the earth can support?

Using the same data for rate of increase, we have:

(a), $(1{\cdot}0015)^n \times 16\ 49 \times 10^8 = 1{\cdot}182 \times 10^{10}$, hence $n = 1314$ years.
(b), $(1{\cdot}0016)^n \times 16{\cdot}49 \times 10^8 = 1{\cdot}182 \times 10^{10}$, " $n = 1232$ "
(c), $(1{\cdot}00864)^n \times 16{\cdot}49 \times 10^8 = 1{\cdot}182 \times 10^{10}$, " $n = 229$ "
(d), $(1{\cdot}01159)^n \times 16{\cdot}49 \times 10^8 = 1{\cdot}182 \times 10^{10}$, " $n = 171$ "

These figures are simply alarming, showing at the present rate we are near the end of our tether. If we reduce the land required to support a person to an acre, it would only defer the evil day of the last figure by 60 years, and that of the second, based on the present rate of increase in France, by about 430 years.

Preachers of large families should take note. The multiplication table is inexorable. You can't fool it.

The antiquity of man upon the earth has been traced back ten thousand years and more. Let us project man 10,000 years into the future and see how he has multiplied, using again the former data:

(a), $(1{\cdot}0015)^{10000} \times 16{\cdot}49 \times 10^8 = 5{\cdot}33 \times 10^{15}$
(b), $(1{\cdot}0016)^{10000} \times 16{\cdot}49 \times 10^8 = 1{\cdot}45 \times 10^{16}$
(c), $(1{\cdot}00864)^{10000} \times 16{\cdot}49 \times 10^8 = 3{\cdot}79 \times 10^{46}$
(d), $(1{\cdot}01159)^{10000} \times 16{\cdot}49 \times 10^8 = 1\ 83 \times 10^{54}$

These are such colossal figures that one utterly fails to comprehend their magnitude. However, we may use a device that will bring it somewhat home to us. We know the size of the earth and its specific gravity, hence we know its mass. Let us assume that

the average mass of a person is 100 pounds. It follows that if we imagine the whole earth converted into people, their number would be $1.31 \times 10^{23}$. If there were that many people there wouldn't be any earth left, for man is but clay. Now look at the figures we had, say due to the average rate of increase of last century, namely ·864 per cent., and we find the population resulting therefrom in 10,000 years is $3.79 \times 10^{48}$, i.e., 3 followed by 23 noughts times the mass of the earth! There is no juggling with figures. Our industrial chemists may come to the relief of man in discovering synthetic food and thereby increase the availability of ground for population, but the absolute ground or surface available will soon put a bar even on this extension.

From all the preceding figures it is evident that we can't go on increasing at our present rate, and the day of reckoning is looming on the horizon with a certainty as great as that the sun will rise to-morrow, and this fact should not be ignored by men gifted with prevision. The only country at the present time that is reasonably living within its assets of land is France, for to double her population requires 433 years.

Our longest period deduced is under 14,000 years, which in the period of geological time reckoned at least at 100 million of years, is a mere bagatelle. Possibly the earth may be overwhelmed by another glacial period, and much of man and his work disappear before the advancing ice, later, thousands of years later, to evolve to his former self. Who knows? But we do know that the population can't go on increasing indefinitely at the present rate. The handwriting is on the wall.

DOMINION OBSERVATORY,
OTTAWA,
August, 1917.

## THE RAINBOW.

TWO LETTERS TO THE EDITOR.

IN his interesting paper on the "Rainbow" (JOURNAL for September, 1917, p. 294) Dr. Klotz suggests a simple mnemonic for the order of the red and violet. Many years ago an even simpler one occurred to me—the word "Rainbow" itself. The first letter, R, tells us that red is at the top or outside of the arch, the last letter, W, tells us that violet (pronounced "wiolet" by Cockneys) is at the lower boundary, or inside of the arch. Also, those who profess to see seven colors in the bow, may note that the word "Rainbow" contains seven letters. Personally, I do not think that as a rule more than five colors are readily distinguishable. I always find the JOURNAL very interesting and instructive. Our Leeds Astronomical Society is very glad to receive it.

26 Nov., 1917.

Will you allow me to supplement a letter recently sent you? In 1902 I wrote to Sir George Stokes, F.R.S., our greatest authority on optics, as to whether a dew bow is seen as a circle or an ellipse.

In reply he said: "It is a question of the combination of sensation and expectation. In a dew bow we are impressed with the idea that the luminosity we see is spread over a horizontal plane; and we tacitly ask ourselves: What must be the actual form of the locus of the drops on the grass in order that the luminosity may appear as it does? The answer, of course, is an ellipse, or it might be an hyperbola. If the question be: As what do we see the bow? The answer depends on a combination of sensation with the interpretation of sensation. If we saw merely the luminosity,

and knew absolutely nothing about its history, we should never think of anything but circularity about it."

The foregoing was published by me in *Nature*, of March, 1916, in connection with Mr. Heath's letter, referred to by Dr. Klotz (p. 295), and I hope it may be considered of sufficient interest to be sent to your Journal.

I may add that just as the dew bow, on a recognized horizontal plane, appears to us as an ellipse, for altitudes of the sun between 41° and the zenith, so also the ordinary rainbow would appear to us as an elliptical arch, if we recognized the drops as occupying a vertical plane at right angles to a horizontal sight-line, the sun's altitude being between zero and 41°. But, there being in the sky no recognizable vertical plane of reference, the ordinary rainbow always appears to us as a circular arch. What I have just added is a summary of what I wrote to *Nature* in connection with the quotation from Sir George Stokes.

Finally, I conclude from his reasoning that the dewbow, seen by us an an ellipse, because we recognize the horizontal plane in which the drops are situated, would convey to us the impression that it was a circle, did we cease to be aware of this plane.

It is not, I believe, even yet known generally that the light of the rainbow is almost completely polarized in planes passing through the eye and the radii of the arch at the points observed This is very easily tested by a Nicol prism.

C. T. WHITMELL.

HYDE PARK,
LEEDS, ENGLAND,
28 Nov., 1917.

## MEETINGS OF THE SOCIETY

### Toronto.

*November* 20.—The fourth regular meeting was held in the Society's Rooms, 198 College St., on the evening of November the 20th. The President, Dr. A. D. Watson, in the chair.

Mr. Hassard reported making some observations on Jupiter recently, being surprised to find that satellite No. 4 does not suffer eclipse at present. Following his remarks there was an interesting discussion by the members.

Professor Chant gave the lecture for the evening on "Planispheres and how to use them." By blackboard illustration the lecturer lucidly explained the construction of planispheres, and then gave many examples of the use of the planisphere and the variety of information to be obtained from their use.

*December* 4.—The fifth meeting was held in the Society's Rooms, 198 College St., on the evening of December 4th. Professor Chant in the chair.

Moved by Mr. John A. Paterson, seconded by Mr. A. F. Hunter, that the President and Secretary be instructed to send a letter of sympathy to Dr. Marsh on the loss of his son, killed in action. Carried.

The following were elected members:—

Prof. Elis Strömgren, University Observatory, Copenhagen, Denmark.

Mr. Joseph McDonogh, Box 261, Cobourg, Ont.

Mr. Hassard made a report on the sun-spots of Dec. 3, and

referred also to the apparent movement of Jupiter which is retrograde.

Mr. Wallace explained a planisphere which he had constructed to show the positions of the planets and sun.

Mr. J. A. Paterson, K.C., gave the paper for the evening on "Aristarchus the Ancient Copernicus." The early history of astronomy was reviewed by the lecturer "from midnight to the Morning Star—Aristarchus, the ancient Copernicus." He showed how the struggles of the early astronomers built up the scaffolding, by means of which the science of present day astronomy was possible to be constructed.

W. E. W. Jackson, Rec. Sec.

## NOTES FROM THE METEOROLOGICAL SERVICE

### Summary Report of the Weather in Canada

### November, 1917

*Temperature.*— The temperature was above the average throughout British Columbia, the Western Provinces and as far as the eastern shores of Lake Superior, elsewhere in the Dominion it was below the average ; the positive departures were very remarkable in the Western Provinces, ranging from 13° to 19° in Alberta and Saskatchewan, and from 8° to 15° in Manitoba. Conditions were also pronounced in British Columbia, with from 4° to 7° in excess of the average. Temperature distribution was also remarkable in Ontario, varying as it did from 5° above the average at Port Arthur to from 3° to 5° below the average from Lake Huron eastward. Quebec and the Maritime Provinces gave marked negative departures of from 3° to 4° and 2° to 6° respectively.

*Precipitation.*— The precipitation exceeded the average amount in the northern portion of British Columbia and in Cape Breton, otherwise it was deficient throughout the Dominion and nearly everywhere to a marked extent. In British Columbia, on Vancouver Island and in many portions of the Lower Mainland, the negative departure varied between four and five inches. In the Western Provinces the total amount was exceedingly light, and in many parts of Southern Alberta and Saskatchewan there was none. In Ontario and Quebec the fall was from one

to nearly two inches below, and over the greater portion of the Maritime Provinces from one to over three inches less than the average. On the other hand the fall of 21·70 at Prince Rupert, B.C., and of 7·2 inches at Sydney, N.S., were both excessive. With the exception of a considerable snowfall in Eastern Ontario and in Quebec on the 22nd, little snow was recorded, and at the close of the month the ground was still bare over a large portion of the Dominion.

## Temperature for November, 1917

| Station | November | | Station | November | |
|---|---|---|---|---|---|
| | Highest | Lowest | | Highest | Lowest |
| *Yukon* | | | Kenora | 51 | 8 |
| Dawson | 16 | -46 | Kinmount | 50 | 5 |
| *British Columbia* | | | Kingston | 53 | 4 |
| Atlin | | | Kitchener | 57 | 6 |
| Agassiz | 61 | 30 | London | 58 | 5 |
| Barkerville | 50 | 12 | Lucknow | 52 | 3 |
| Kamloops | 55 | 21 | Markdale | | |
| New Westminster | 65 | 33 | North Gower | | |
| Prince Rupert | 66 | 31 | Oshawa | | |
| Vancouver | 59 | 34 | Ottawa | 52 | - 7 |
| Victoria | 61 | 37 | Paris | 58 | 9 |
| | | | Parry Sound | 49 | - 3 |
| *Western Provinces* | | | Peterboro' | 54 | - 1 |
| Battleford | 68 | 6 | Port Arthur | 58 | 0 |
| Calgary | 67 | 15 | Port Burwell | 53 | 13 |
| Edmonton | 66 | 13 | Port Dover | 52 | 9 |
| Medicine Hat | 68 | 11 | Port Stanley | 55 | 11 |
| Minnedosa | 60 | 8 | Queensborough | 51 | -12 |
| Moose Jaw | 66 | 10 | Ronville | 49 | 2 |
| Oakbank | 58 | 8 | Southampton | 53 | 8 |
| Portage la Prairie | 54 | 12 | Sundridge | | |
| Prince Albert | 64 | 6 | Stonecliffe | 50 | - 6 |
| Qu'Appelle | 62 | 13 | Stony Creek | 55 | 11 |
| Regina | 59 | 9 | Toronto | 54 | 10 |
| Saskatoon | 59 | 11 | Uxbridge | 55 | - 5 |
| Souris | 61 | 9 | Wallaceburg | 63 | 17 |
| Swift Current | 64 | 10 | Welland | 55 | 8 |
| Winnipeg | 52 | 12 | White River | 54 | -24 |
| *Ontario* | | | *Quebec* | | |
| Agincourt | 57 | 6 | Brome | 47 | -14 |
| Aurora | 54 | 0 | Father Point | 40 | -10 |
| Bancroft | 49 | -15 | Montreal | 46 | 2 |
| Barrie | 58 | 4 | Quebec | 40 | - 6 |
| Beatrice | 51 | - 3 | Sherbrooke | 44 | - 8 |
| Bloomfield | 51 | 4 | | | |
| Chapleau | 54 | -16 | *Maritime Provinces* | | |
| Chatham | 64 | 18 | Charlottetown | 52 | 16 |
| Clinton | 51 | 11 | Chatham | 50 | - 2 |
| Collingwood | | | Dalhousie | | |
| Cottam | 61 | 11 | Fredericton | 50 | - 5 |
| Georgetown | 54 | 7 | Halifax | 56 | 18 |
| Goderich | | | Moncton | 53 | 6 |
| Grimsby | | | St. John | 51 | 6 |
| Guelph | 55 | 5 | Sussex | 50 | 5 |
| Haliburton | 50 | -11 | Sydney | 56 | 16 |
| Huntsville | 57 | - 4 | Yarmouth | 56 | 18 |

## Earthquake Records by the Milne Seismograph

### TORONTO

Sir Frederic Stupart, Director.

P.T. = Preliminary Tremors. S. = Secondary Waves. L.W. = Large Waves. A.C. = Air Currents. Time is Greenwich Civil Mean Time, 0 or 24 h = midnight.

| No. | Date 1917 | P. T. Comm. | S. Comm. | L.W. Comm. | Max. | End | Max. Amp. | Remarks |
|---|---|---|---|---|---|---|---|---|
| | | h m | h m | h m | h m | h m | mm | |
| 1778 | Nov. 4 | | | 13 04·9 ) | 13 49·1 | 14 57·5? | 0·3 | |
| | | | | 13 19·8 ) | | | | |
| 1779 | " 7 | | | 1 49 8 | 1 51·0 | A.C. | 0·3 | |
| 1780 | " 8 | | | 6 04·8 | | | 0·1 | A. C. going on. |
| 1781 | " 14 | | | 9 51·8 ) | 9 58·0 | 10 31·7 | 0·3 | |
| | | | | 9 57·3 ) | | | | being seismic. |
| 1782 | " 15 | | | 1 58·2 | 1 58·5 | | 0·2 | Doubtful as to |
| 1783* | " 16 | 3 38·6 | 3 49·8 ) | 4 09·6 ) | 4 25·6 | 7 01·0? | 9·2 | 10,310 km. S. |
| | | | 3 50·5 ) | 4 23·2 ) | | | | waves well de- |
| | | | | 23 21·2 ) | | | | fined. |
| 1784 | " 16 | | | 23 41·3 ) | | 23 56·9 | 0·1 | |
| 1785 | " 18 | | | 3 36·5 | | 3 42·4 | 0 05 | |
| 1786 | " 18 | | | 4 01·1 ) | 4 21·6 | 5 02·1 | 0·2 | |
| | | | | 4 10·8 ) | | | | |
| | | | | 12 11·4 ) | | | | |
| 1787 | " 24 | | | to | | | 0·05 | A. C. going on. |
| | | | | 12 16·6 ) | | | | |
| 1788 | " 29 | | | 22 56·3? ) | | | 0·05 | |
| | | | | 23 03·9? ) | | | | |
| 1789 | " 30 | | | 18 05·1 ) | | 18 25·6? | 0·05 | |
| | | | | 18 08·5 ) | | | | |

Boom period 18 seconds. Pillar inclination 1mm. = 0″·45.

* It is believed that the centre of earthquake No. 1783 was located approximately in the Kermadec Islands, a small British archipelago off the east coast of Australia.

## VICTORIA, B. C.

F. N. DENISON, SUPERINTENDENT.

| No. | Date 1917 | P.T. Comm. | S. Comm. | L.W. Comm. | Max. | End | Max. Amp. | Remarks |
|---|---|---|---|---|---|---|---|---|
| | | h m s | h m s | h m s | h m s | h m s | mm | |
| 1791 | Nov. 4 | 12 33 02 | 12 46 48? | 12 53 41 | 13 20 14 | 13 49 45 | 0·6 | 13,000 km. |
| 1792 | " 7 | 0 49 12? | | | 1 48 18 | | 0·4 | [S. |
| 1793 | " 14 | 9 30 26 | | 9 39 22 | 9 46 18 | 9 53 15 | 0·1 | P. phase may be |
| 1794 | " 16 | 3 32 27 | 3 42 52 | 3 57 15 | 4 11 08 | 6 33 27 | 3·0 | 9,290 km. |
| 1795 | " 16 | | | 23 19 01 | | | 0·05 | |
| 1796 | " 18 | | | 3 22 35? | 3 30 30 | | 0·1 | |
| 1797 | " 18 | 3 41 54? | 3 46 22? | 3 54 48? | 4 02 04 | 4 44 23 | 0·2 | |
| 1798 | " 28 | 15 21 31? | | | 15 23 29 | 15 26 28 | 0·1 | May not be |
| 1799 | " 29 | | | 23 00 09 | 23 04 09 | 23 09 30 | 0·3 | [quake. |
| 1800 | " 30 | | 17 44 43? | 17 48 42? | 17 55 38 | 18 05 01 | 0·5 | |

Boom period 18 seconds. Pillar inclination 1mm. = 0″·50

### VERTICAL SEISMOGRAPH

| Date 1917 | P.T. Comm. | S. Comm. | L.W. Comm. | Max. | End | Max. Amp. | Remarks |
|---|---|---|---|---|---|---|---|
| | h m s | h m | h m s | h m | h m s | $\mu$* | |
| Nov. 16 | 3 32 00 | | 4 02 00 | 4 05 00 | | 10 | *True earth movement. |

J. Y.

# MAGNETIC OBSERVATIONS

## OCTOBER, 1917

Large disturbances in the Magnetic Forces were recorded both at Agincourt and Meanook on October 3, 14, 25, 28 and 29. On the first three dates they were of short duration, but on the latter the disturbance began about 1 a.m. on October 28 and continued as an active disturbance until about noon of the 30th.

Numerous sun-spots were observed during the latter half of the month, more particularly north of the equator.

### AGINCOURT MAGNETIC OBSERVATIONS

Lat. 43° 47′ N.; Long. 79° 16′ W.

| October, 1917 | | D. West | H | Z | I |
|---|---|---|---|---|---|
| | | ° ′ | γ | γ | ° ′ |
| | Mean of Month | 6 37·0 | 15932 | 58411 | 74 44·6 |
| | Maximum | 7 24·5 | 16049 | 58554 | |
| | Date of Maximum | 3 | 28 | 28 | |
| | Minimum | 5 52·5 | 15613 | 58238 | |
| | Date of Minimum | 3 | 25 | 29 | |
| | Monthly Range | 1 32·0 | 436 | 316 | |
| Mean Daily Amplitude | From hourly readings | 10·6 | 43 | 23 | |
| | From means of extremes | 24·0 | 93 | 56 | |

### MEANOOK MAGNETIC OBSERVATIONS

Lat. 54° 37′ N.; Long. 113° 21′ W.

| October, 1917 | | D. East | H | Z | I |
|---|---|---|---|---|---|
| | | ° ′ | | | ° ′ |
| | Mean of Month | 27 46·7 | 12944 | 60541 | 77 55·9 |
| | Maximum | 29 48·3 | | | |
| | Date | 29 | | | |
| | Minimum | 26 35·1 | | | |
| | Date | 29 | | | |
| | Monthly Range | 3 13·2 | | | |
| Mean Daily Amplitude | From hourly readings | 14·1 | | | |
| | From means of extremes | 56·3 | | | |

H and Z are given in Gammas. (1 γ = 0·00001 C.G.S.).

All results are reduced to International Magnetic Standard.

The value for I at Meanook is the mean of all the observations made during the month without regard to the time of day.

The value of H at Meanook is the mean of two observations made about the middle of the month, and the Z is obtained by the formula Z = H tan I.

W. E. W. J.

## ASTRONOMICAL NOTES

NEBULOSITY ABOUT NOVA PERSEI (1901).—Of six negatives recently secured with the 60-inch reflector showing the nebulosity discovered by Barnard in December, 1916.

The 10-minute plate of September 19 showed a nebulous spot lying in position angle 210°, 10″ distant from the nova. The remaining plates all show the nova involved in nebulosity with the strongest condensations on the south-preceding side. These condensations give a fan-shaped appearance to the nebulosity on that side, which resembles in many ways the nebulosity appearing in the original outburst in 1901.

The bright knot mentioned above does not appear in the 1901 photographs. Two curved wisps, however, concave toward the nova, lying at either side of the knot and inclined in position angle 125°, bear a close resemblance in form and are in the same position angle as those shown in the 1901 photographs, their distance from the nova being one-tenth that of the earlier outburst.

From the preceding of these knots a wisp inclined in position angle 200° extends northward, passing the nova on the preceding side.

There is no certain change in the position of any of the details in the interval between these plates.—FRANCIS G. PEASE, *Publications Society of the Pacific*, December, 1917.

A NEBULOUS RING ABOUT NOVA PERSEI—A negative of the region of Nova Persei taken with the 60-inch reflector October 16, 1917, shows strongly the small fan-shaped nebula

adjacent to the nova described by Mr. Pease in the preceding note.

This negative shows also a sharply defined continuous ring of nebulosity about 16″ in diameter, nearly circular, with the nova at its centre. Some details of structure are shown in the ring, notably a large bright patch and a slight doubling of the ring in the north-east quadrant.

This ring will be watched with much interest to see whether it is expanding. If it be the result of the sudden increase of brightness of 1½ magnitudes in the nova between Aaugust 16 and August 28, 1917, as described by Bélopolsky (*Harvard Bulletin* 643), the present ring may prove to be analogous to the great expanding rings photographed around this nova in 1901-2, but on a much smaller scale.—G. W. Ritchey, *Publications Society of the Pacific*, December, 1917.

Another Faint Nova in the Andromeda Nebula.—A negative of the Andromeda Nebula (N. G. C. 224) taken October 16, 1917, with the 60 inch reflector shows another faint nova; the magnitude is about 18, and the distance from the nucleus approximately 255″ south and 26″ west. The nova is invisible on a fine negative taken September 17, 1917, which shows stars fainter than magnitude 20; it is also invisible on all of the series of 16 earlier negatives of this region, the best of which show stars probably as faint as magnitude 21. The reality of the nova is confirmed by a negative made October 13, 1917, by Mr. Shapley, whose estimates of brightness give the magnitude as 17·9 and 18·1 on October 13 and October 16, respectively.

The nova recently found in this nebula by Mr. Shapley is fainter than magnitude 20 on the plate of October 16, having decreased at least two magnitudes within an interval of one month.

Five novæ in the Andromeda Nebula are now on record, including that of August, 1885.—G. W. Ritchey, *Publications Society of the Pacific*, December, 1917.

JOURNAL OF THE ASTRONOMICAL SOCIETY OF INDIA.—At the meeting of the Royal Astronomical Society on November 9 last, Mr. Evershed, Director of the Kodaikanal Solar Observatory in India, contributes an article with photographs of a very fine prominence, taken on May 26th 1916, showing luminous matter shot out from the sun to a height of more than half a million miles, with a velocity of nearly 300 miles per second. The density of the erupting matter was computed to be one-four thousand millionth part of that of gas in a vacuum-tube under a pressure of only one millimetre.

Professor Eddington gave an account of a paper by Dr. de Sitter, of Groningen, on "Einstein's Theory of Gravitation," drawing attention to some curious consequences of the assumption of curvilinear space. One of these was the theoretical existence of a point where the ordinary conception of three dimensions in space and one in time is reduced to space only, with no time at all, but this can only refer to an epoch before the beginning or after the end of eternity. Another consequence is that no star can have a parallax less than about one-twentieth of a second of arc, which means a limited converse. A third somewhat paradoxical result is that, for a suitable value of the curvature of space, light from the back of the sun should be faintly visible at the opposite point of the sky.—*English Mechanic and World of Science*, November 16.

THE BEST SERVICE OF ASTRONOMERS IN TIME OF WAR.—In the organization of the work of the National Research Council I have naturally given much consideration to the question of what service astronomers can render to the country during the period of the war. In Europe, as I found during a brief visit last summer, a number of astronomers have been engaged in war service. Count de la Baume Pluvinel has invented a device for detecting the presence of bits of shrapnel in the body; M. Chrétien was engaged on mathematical investigations bearing on the theory of airplanes; while M. Deslandres and other French astronomers were in the artillery service or otherwise occupied

with military duties. In England the Astronomer Royal was engaged in testing of certain instruments, Professor Newall had under construction a new type of range-finder for use against Zeppelins, and others were in active service with the army. Among these I may mention Mr. Capon, formerly of Oxford, who was at Mount Wilson during the early part of the war, and is now a prisoner in Germany, after having been wounded twice in the aviation service. In Italy, our former colleague Dr. Abetti, who is now in this country as the Italian representative of the French Scientific Mission, has done useful service at the Italian front in photographing the Austrian lines. Other cases might be mentioned, but these will suffice to indicate some of the kinds of work that astronomers may do.

In this country, although we have been constantly on the lookout for opportunities, few pieces of work have yet been found in which astronomers could advantageously take part. Comparatively few problems come to the National Research Council directly from the Government. Our experience has been similar to that of other departments of the Council of National Defense, which have made themselves useful by discovering and developing their own possibilities for service. Some of our committees have been very successful in this respect, but in astronomy the opportunities have been fewer than in almost any other field.

Surveying the various possibilities that seem to lie open to astronomers, we find that most of them may be grouped under the following heads: (1) instruction in navigation; (2) invention or development of military devices; (3) scientific service with the army; (4) statistical or other similar work for the Government. In addition to these possible services in which technical knowledge is of value, there is the opportunity, which has been embraced by some of our fellow members, of joining the fighting forces of the Army or Navy, and the possibility, regarding which I shall have more to say in a moment, of continuing astronomical research. Let us consider briefly the opportunities for usefulness in these various fields.

There remain to be considered the great majority of astrono-

mers, whose duty and privilege it will be to carry forward their investigations during the period of the war. Recent events, both in Europe and the United States, have emphasized in the strongest manner the dignity and importance of scientific research. The tendency shown by some critics of limited view to measure the importance of research in terms of its immediate applicability to practical affairs is not justified by the facts. On the contrary, it is certainly fair to say that no science has done more for the world than astronomy. This is not chiefly because of its determination of the time, or the system of navigation it has developed, fundamentally important though these be. It is rather because of the sweeping change in human thought that astronomy has wrought and is still effecting, and the stimulating influence of the oldest of the sciences upon other sciences of later development. But I need not dwell on a theme which has been so luminously developed by Poincaré in "La Valeur de la Science." In his demonstration of the importance of astronomy to the world we find ample justification for the work we are doing, and the strongest encouragement to continue its pursuit in the interest of national progress.—GEORGE E. HALE, from Report of the Twenty-First Meeeting of the American Astronomical Society, in *Popular Astronomy*, December, 1917.

THE death is announced, while leading his platoon, during one of the recent advances in France, of Second Lieutenant F. Entwistle, second assistant at the Observatory, Cambridge, aged twenty-one years. Mr. Entwistle was a computer at the Royal Observatory, Greenwich, and he went to Cambridge as second assistant in December, 1914. He was there a few months only before he was given a commission in the Norfolk Regiment as second lieutenant. Mr. Hartley, first assistant at the Cambridge Observatory was killed on the Vanguard on July 9.

J. R. C.

## NOTES AND QUERIES

**Communications are Invited, Especially from Amateurs. The Editor will try to Secure Answers to Queries.**

### AMATEUR OBSERVATIONS.

The notes of observations by Mr. A. R. Hassard, recently printed in the JOURNAL, were of interest to all, but were especially appreciated by those who have been drawn to astronomy purely by a love to study the heavens. The Editor was pleased to receive in a personal letter from Dr. Leslie G. Pearce, of Brantford, a short account of some of his work with his 3-inch telescope, and takes the liberty of printing a portion.

"In September I obtained from Mr. F. L. Blake, of the Meteorological Office, Toronto, data regarding the position of Uranus. He very kindly furnished me with a small blueprint, showing just about where to look for him. I then carefully mapped out the particular portion of Capricornus indicated, taking in a rather large field and plotting everything seen down to about the seventh mag. I made two subsequent maps of the same field at intervals of about nine or ten days. By comparing the series I located Uranus by his displacement. Having found him, I tried out the highest powers that he would bear, which were for my aperture two hundred diameters. I distinctly saw his disc-like form, which showed the absence of diffraction rings. Of course the sight was not much, but it repays one as does every glance into the depths of space, and there is a satisfaction in knowing that I actually observed his displacement as he swings in his gigantic orbit so far away from us.

"I have had some splendid views of Jupiter this fall, and the

amount of detail and color to be seen on his changing surface, even with my small telescope, is amazing. Like Saturn, Jupiter is a telescopic object to which one returns many times with increasing interest.

"I had a splendid view of the moon two nights ago. The Mare Crisium lay beautifully in the morning sun, its central craters showing up magnificently. Petavius lay close to the terminator, its central mountain casting long shadows far over the crater floor, while the great crack, extending from the mountain in the centre to the wall of Petavius, was just beginning to glisten in the sunlight. The moon, indeed, furnishes many hours of keen enjoyment, even for an amateur."

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## PARALLAX OF THE STARS.

In order to make a satisfactory study of the stellar universe, it is necessary to know the distances of the stars, but, as is well known, the measurement of these distances has proved to be the most arduous and difficult of all astronomical problems. In recent years, however, considerable progress has been made by using the photographic method, and there has just been published part 1 of volume 4 of the Publications of the Yerkes Observatory, containing a record of the determination at that institution of the parallaxes of 131 stars.

Prof. G. W. Ritchey first showed that the 40-inch refractor could be successfully used for celestial photography, and Director Hale in 1902 took up the matter of utilizing stellar photographs taken with it for determining parallax. In May, 1903, Dr. Frank Schlesinger began preliminary experiments to establish the best procedure for taking the plates, measuring them and making the required reductions. In this he was signally successful, and the work thus inaugurated has borne much fruit not only at the Yerkes, but also at Allegheny (under Schlesinger), Leander McCormack (under Mitchell), Sproul (under Miller) and perhaps other places.

It may be interesting to give a few results for some well-known stars. Where the parallax is minus the star was found to be farther away than the one with which it was compared.

| Star | Parallax | Star | Parallax |
|---|---|---|---|
| $\beta$ Persei (Algol) | + ·020 | $\epsilon_1$ Lyræ pr | − ·003 |
| Orion Trapezium A | − ·005 | fol | − ·007 |
| " " B | − ·014 | $\epsilon_2$ Lyræ pr | + ·006 |
| " " C | − ·026 | fol | + 0·12 |
| " " D | − ·021 | Nova Lacertæ | + ·007 |
| Nova Geminorum No. 2 | + ·006 | 61$_1$ Cygni | + ·267 |
| Z Herculis | + ·028 | 61$_2$ " | + ·277 |

## DEATH OF ALEXANDER LAING.

On the evening of December 4, 1917, Alexander Laing died at the family residence, 376 Hurlbut Ave., Detroit. He was well known as a lecturer on astronomical geography, and as the inventor of a planetarium. He was a member of the Royal Astronomical Society of Canada.

Mr. Laing was born near Montreal 72 years ago of Scottish parents, and it is worth remarking that of the twelve children seven were boys, and they all became elders in the Presbyterian Church. One of the worthy seven is Mr. A. T. Laing, B.A.Sc., secretary of the Faculty of Applied Science of the University of Toronto.

C. A. C.

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